

Study of the Ecological impact of sewage-irrigated vegetable farming of Calcutta Metropolis using Remote Sensing & GIS

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Abstract

The East Kolkata Wetland (EKW) area, a Ramsar site, which is known as the kidney of the mega city Kolkata consists of different types of land use pattern including sewage fed fisheries and garbage farming. An estimated amount of approximately 250 gallons of sewage and 2700 ton of garbage per day are discharged into the EKW. This paper is attempted to show how to monitor the land use change in EKW area receiving city sewage and garbage from the city using the space borne optical data like LISS III and IKONOS data. This database will be used for development of the interpretation protocol for microwave data like PALSAR.

1. Introduction:

The East Kolkata Wetlands are well known over the world for their multiple uses. The resource recovery system, developed by the local people through ages using wastewater from the city, is the largest in the world and unique of its type. In the process, it treats the wastewater and has saved the city of Kolkata from constructing and maintaining mammoth wastewater treatment plant. The multifunctional wetland ecosystem is comprises 254 sewage fed fisheries, agricultural field, solid waste farms and some built up areas in addition to the wetland. A large part of wetland happens to be the world's largest wastewater fed aquaculture system and the goods and services offered by this wetland include, in addition to fisheries, water treatment, provision of habitat to waterfowl and a large amount of biodiversity.

In August 2002, 12,500 ha of the East Kolkata Wetland area has been included in the 'List' maintained under the Ramsar Bureau established under the Article 8 of the Ramsar Convention, that has given this wetland the recognition of a "Wetland of International Importance". But this EKW is undergoing a continuous threat of rapid land use change due to increased need for housing and economic development in the city. So need of the time is to take steps for conservation and management of the EKW area by stopping these conversions attempt as a part of conservation and

management of the EKW GIS and Remote Sensing can play a very important rule in this respect.

2. Objectives:

The objective of this paper is to create a spatial database of sewage flow system of Calcutta Metropolis in GIS Environment using space borne data which will be used later to monitor the change in the sewage flow over the seasons, crop status in the sewage fed farms and condition of sewage fed fishery ponds and modeling the nutrient cycle and toxicity in food chain using ALOS AVINIR-II data.

3. Study Area:

The study area is East Kolkata Wetlands located along the Kolkata city in the state of West Bengal, India. Kolkata Metropolis is one of the largest urban agglomerations in the country with a population of 14.72 million and a density of 7950 persons/km². The study area is located along the eastern part of the Kolkata city and some part overlapped with the city. The East Kolkata Wetlands comprises of Kolkata Municipal Corporation and the Bidhananagar municipal Corporation and the Panchayat Area. The weather of the city is quite humid with variation from 50% to 85% and typical temperature variation from 4^oC to 8^oC.

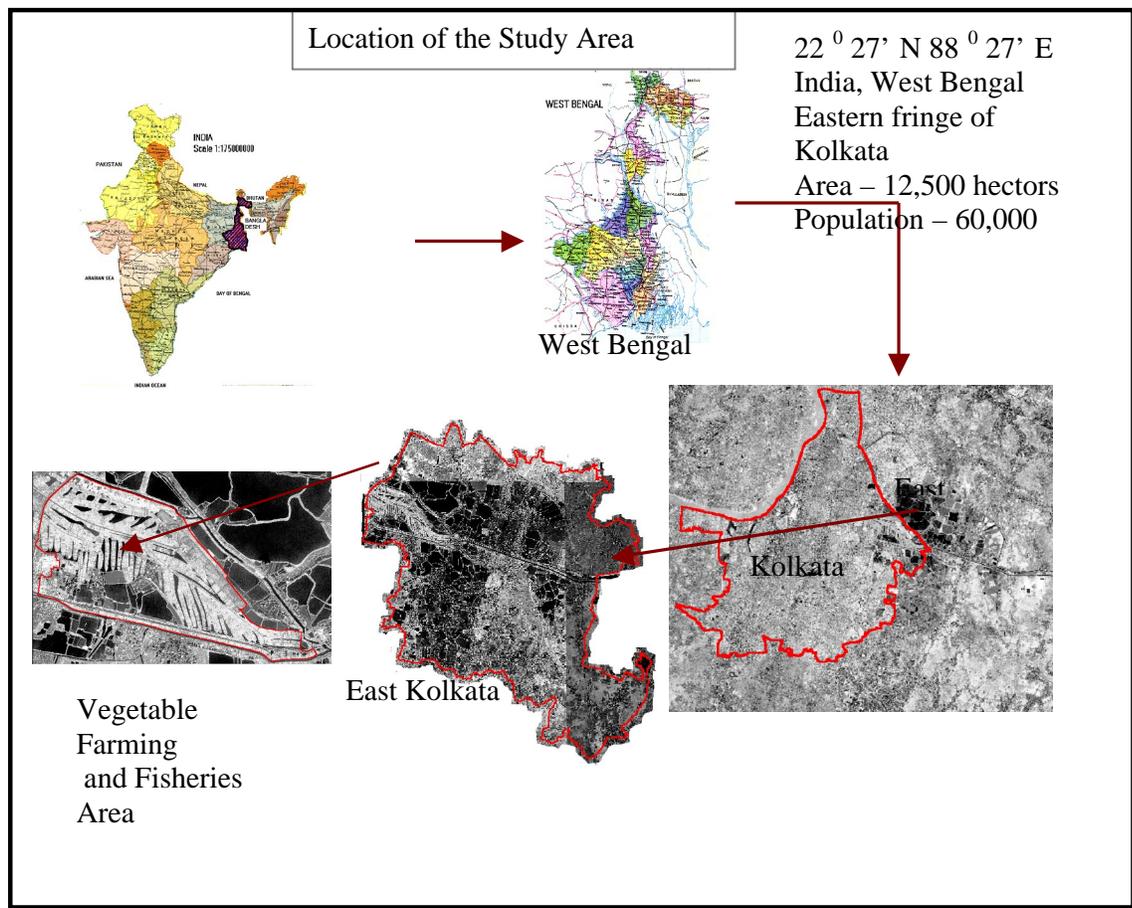


Figure 1: Location of the Study Area

The rainy season lasts from June to October and brings moderate rainfall averaging 160.5cm.

4. Methodology:

High-resolution satellite data of the concerned area is procured. Here CARTOSAT-PAN and Multi-Spectral data are used resolution of which is 1metreX1metre in PAN and 4meter X 4meter in Multi-spectral. Cadastral Maps of the area is collected and geographically referenced with the satellite data. For this purpose image to image registering process is used. The boundary was demarcated with the help of satellite data, cadastral map and ground truth data. Plot level boundary is delineated from the cadastral map and overlaid on satellite image. From this present land use is detected and a list is prepared showing the details use of each plot. So that in future legal steps could be taken so that conversion could be restricted. In the second stage spatial database is created for different components of the system like canals, sewage channels, soil, vegetable farms, crop status at different

times of the year, fishery sites etc. using LISS III and PAN merged data of the project area of different time period. The accuracy of identification and classification of the LISS III/PAN merged data is evaluated with the ground truth data.

The database will be updated using ALOS data. Vegetation indices will be derived to monitor the crop growth, condition and utilization pattern.

Data will be collected at various sample points on composition of sewage, toxic chemicals at various channels at different times of the year. This will be modeled to study the flow concentration at various channels, the intensity of toxicity and its effect on vegetables and soil.

5. Discussion and Result:

Plot level boundary and Land use of the study area is delineated using cadastral map and satellite data.

Spatial Database creation of the study area for canals, sewage channels, and vegetable farming area is already done using LISS III and PAN merged data.

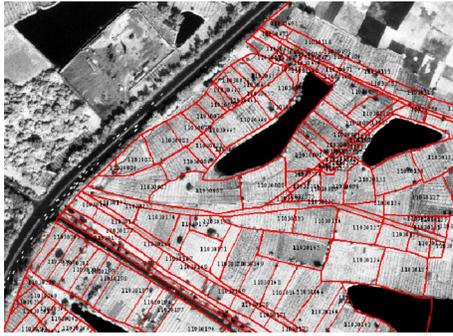
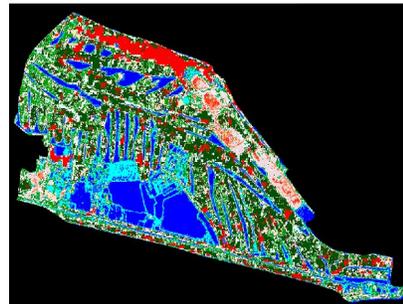


Figure 2 Plot level boundary overlaid on the IKONOS data

In the East Kolkata Wetlands three types of landuse practices are seen these are the farming with city garbage, sewage fed pisciculture and paddy cultivation using both sewage and effluents from the fisheries. It is thus necessary to show the field situation and corresponding satellite data.



(a)

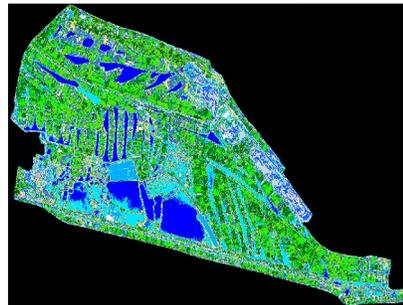


(b)

Figure 3a and 3b : Image of PAN-LISS III merged data and classified image



(c)



(d)

Figure 3 c and 3d : Image of IKONOS Multispectral data and classified image

It is to be mentioned that in East Kolkata in the waterbodies sector number of big fish ponds/ wetlands receive raw sewage and produce fish and other animal protein with the help of sunlight through the photosynthesis process.



Figure 4 Garbage and sewage farming

5.1 Land use Classification

Regarding landuse classification mouza wise dag boundaries are overlaid on the IKONOS images through proper GCP points. The information of dag numbers and other related informations are kept in Arc/Info environment. A query system is developed to retrieve the information relating to a particular plot.

It is so accurate that the Govt. has used this result for enactment of a legislation related to landuse control in the RAMSAR site- East Kolkata Wetlands.

6. References

[1] The Kolkata Gazette West Bengal Act VIII of 2006
The East Kolkata Wetlands (Conservation and
Management) Act, 2006.